

ZOOLOGY.—*A new genus for the nematode Filaria cistudinis Leidy, 1856, of the family Filariidae.*¹ JOSEPH E. ALICATA, Bureau of Animal Industry. (Communicated by BENJAMIN SCHWARTZ.)

The material on which the discussion of the nematodes described in this paper is based, consists of a male and two females collected by the writer from the heart cavities of a turtle, *Terrapene carolina*. The host animal was captured in June, 1932, in the vicinity of Washington, D. C. The nematodes in question belong to the family Filariidae Baird, 1853, emend. Claus, 1885, and to the subfamily Aproctinae Yorke and Maplestone, 1926, and possess characters which differ from those of any of the existing genera of the subfamily. They are accordingly considered as constituting a new genus for which the name *Cardianema* is proposed.

The filarids discussed in this paper are probably identical with the species reported by Leidy (1856) as *Filaria cistudinis* from the heart of the same species of turtle, *Terrapene carolina*, presumably collected in Pennsylvania. Leidy's description of the form reported by him is as follows: "*Filaria cistudinis*. Body capillary, spirally involute, attenuated at the extremities. Head and tail obtusely rounded. Mouth unarmed. Anus terminal. Length $1\frac{1}{2}$ inches, breadth $\frac{1}{8}$ of a line. One specimen was obtained by Mr. Schafhirt from the heart of *Cistudo carolina*." Although Leidy's description is meager, the occurrence in the same host and the same location, both in the eastern United States, and the general appearance of the worms, which shows a similarity between the form described by Leidy and those found by the writer, indicate that the writer's material is *Filaria cistudinis*. The only detail in Leidy's description which does not apply to the writer's specimens is the position of the anus. Leidy, as noted above, reports the anus as terminal; the present writer finds that it is located some distance from the tip of the tail. Because the anus of this parasite, and of filarids generally, is inconspicuous and rather easily overlooked, it is probable that Leidy actually overlooked the anus, and that he mistook a cuticular structure or indentation for the anus. The specific name proposed by Leidy for the turtle heart-filarid is retained in this paper, the name of the species becoming *Cardianema cistudinis* (Leidy, 1856).

The systematic position of the parasite is as follows:

Subfamily APROCTINAE Yorke and Maplestone, 1926

Subfamily diagnosis.—Filariidae: Mouth simple, usually without lips;

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cuticle smooth or with longitudinal or transverse striations; trident-like structures on each side of anterior end of esophagus absent; vulva anterior, or slightly posterior, to terminal portion of esophagus; spicules relatively short, equal or subequal, and similar; anus usually not functional, sometimes absent.

The position of the genus *Cardianema* in the subfamily Aproctinae and the relationship of this genus to the other known genera of this subfamily are shown in the following key:

KEY TO GENERA OF SUBFAMILY APROCTINAE

The genera included in this subfamily, with their distinguishing characters, have been taken for the most part from Yorke and Maplestone's (1926) key.

1. Anterior portion of spicules tubular and chitinous, posterior portion twisted and membranous; parasites of circulatory system of turtles
.....*Cardianema*
Spicules not divided into tubular and membranous portions.....2
2. Males with caudal alae; parasites of muscles and tendons of legs of birds
.....*Pelecitus*
Males without caudal alae.....3
3. Amphidelphic.....4
Opistodelphic.....5
4. Mouth surrounded by a cuticular collar; parasites of subcutaneous tissue of birds.....*Squamofilaria*
Mouth simple, without a cuticular collar; parasites of body cavity of birds.....*Chandlerella*
5. Esophagus very narrow and transparent; parasites of subcutaneous tissue of birds.....*Eufilaria*
Esophagus of ordinary type.....6
6. Posterior extremity of both sexes digitiform and prolonged considerably beyond anus; parasites of subcutaneous connective tissue of geckos
.....*Thamugadia*
Posterior extremity of both sexes terminating very close to tip of tail..7
7. Esophagus divided into a short anterior narrow portion, and a long posterior wider portion; parasites of mesentery of lizards.....*Saurositus*
Esophagus not divided into two distinct portions.....8
8. Gubernaculum absent; parasites of orbital and nasal cavities of birds
.....*Aprocta*
Gubernaculum present; parasites of birds; location unknown
.....*Pseudaprocta*

Cardianema, new genus

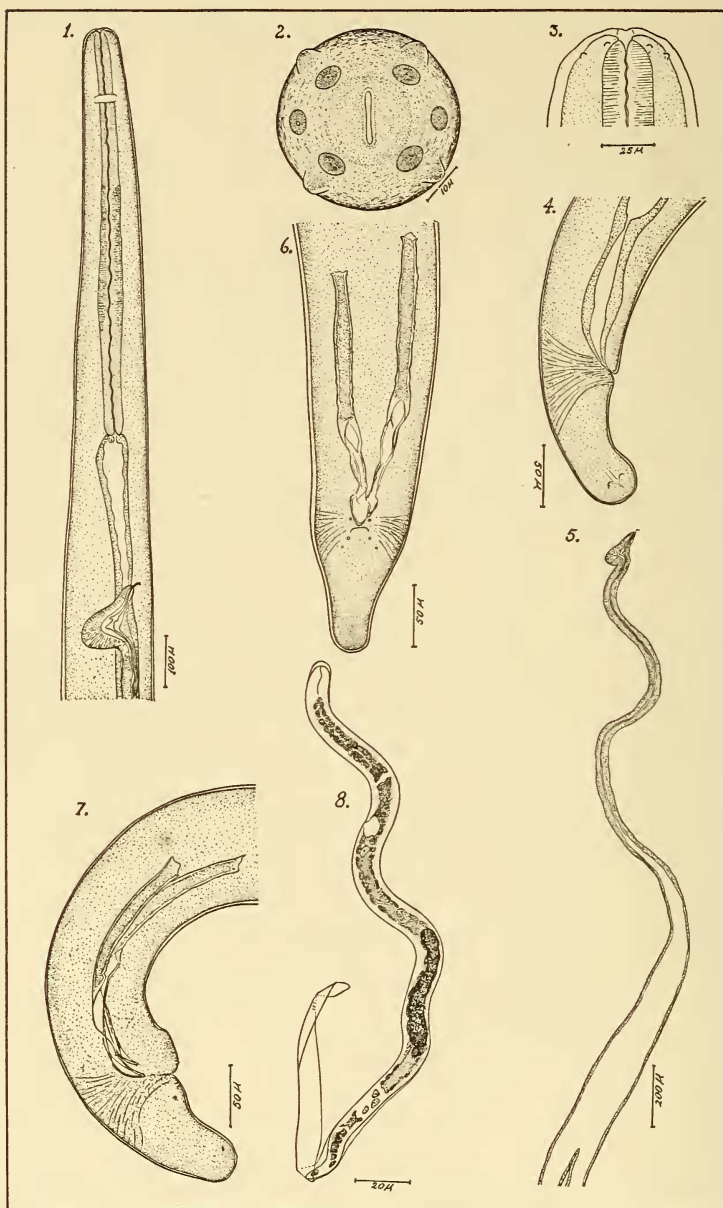
Generic diagnosis.—Aproctinae: Long and slender worms, whitish in color, loosely coiled, and attenuated toward extremities. Cuticle with fine longitudinal striations. Mouth simple, elongated dorso-ventrally, surrounded by 4 pairs of submedian papillae and a pair of lateral papillae or amphids. Esophagus simple, relatively long and slender. *Male* with slender, subequal spicules, consisting of an anterior tubular portion and a posterior membranous portion, the latter terminating in a spade-like tip. Caudal papillae small and indistinct, consisting apparently of one pair of pre-anal and two

pairs of post-anal papillae. Tail relatively long, bluntly rounded terminally, and curved ventrally. *Female* vulva slightly posterior to terminal portion of esophagus. Vagina in two parts, an anterior portion or true vagina, which is short, wide and sac-like, and a posterior portion or uterine vagina, which is tubular and slender for most of its length, but widens as it unites with two parallel uteri. Uterus opisthodelphic; worms ovoviviparous, uterus containing eggs and larvae. Tail relatively long, bluntly rounded terminally, and curved ventrally. Microfilariae sheathed and occurring in the blood.

The distinguishing features of the genus *Cardianema* are: The spicules are not uniform in structure as are those of other genera of the subfamily; in *Cardianema* each spicule is made up of three distinct parts, namely, a straight, tubular, well chitinized proximal portion, followed by a transparent, twisted membranous median portion, and a terminal spade-like posterior portion. Of the genera of Aproctinae, six are parasites of birds, while the two remaining genera, *Saurositus* and *Thamugadia*, each represented by one species, are parasites of lizards. It should also be noted that *Cardianema* is apparently the only member of the Aproctinae occurring in the circulatory system. The other members of the subfamily have been found in other locations as shown in the key to the genera of Aproctinae.

CARDIANEMA CISTUDINIS (Leidy, 1856)

Specific diagnosis.—*Cardianema*: Characters of the genus. Worms slender, filiform and loosely coiled. Head rounded, and provided with 4 pairs of submedian papillae and one pair of lateral papillae or amphids (Figs. 2 and 3). Esophagus relatively long and slender (Fig. 1). *Male* (description based on writer's one specimen) 2.5 cm. long and 235μ in maximum width near equator of body. Esophagus 873μ long by 34μ in maximum width. Nerve ring 159μ from anterior extremity. Excretory pore not observed. Spicules (Figs. 6 and 7) subequal; right spicule 201μ long, consisting of a chitinized proximal tubular portion 117μ long, a median membranous portion 53μ long, and a spade-like posterior tip 31μ long; left spicule longer than right spicule, 221μ long, proximal tubular portion 129μ long, membranous portion 72μ long, and spade-like tip, which is smaller than that of right spicule, 19μ long. Cloaca 86μ from tip of tail; muscles surrounding cloaca prominent; papillae surrounding cloaca small and indistinct; one pair of pre-anal and two pairs of post-anal papillae observed. Tail directed ventrad (Fig. 7). *Female* (description based on writer's two specimens) 2.7 to 3.2 cm. long by 266 to 288μ in maximum width near middle of body. Esophagus 775 to 988μ long and 42 to 53μ in maximum width. Nerve ring 125 to 152μ from anterior extremity. Excretory pore not observed. Vulva (Figs. 1 and 5) opens just below terminal portion of esophagus, 1.107 to 1.28 mm. from anterior end. According to measurements of one specimen, true vagina (Fig. 5) short and sac-like, 150μ long by 91μ wide; uterine vagina tubular, 2.2 mm. long, 45μ wide at junction with sac-like portion of true vagina, and widening to 144μ at the point where it joins the two uteri. Uteri contain eggs and larvae; eggs in uteri oval, about 26μ long and 11 to 15μ wide. Two larvae *in utero* were 225μ long and 9μ in maximum width, which corresponds approximately to size of larvae found in blood. Anus small, 99μ from tip of tail; muscles surrounding anus prominent. Tail curved ventrad; tip bluntly rounded (Fig. 4).



Cardianema cistudinis.—1. Female, anterior portion (ventro-lateral view); 2. Female, anterior end (*en face* view); 3. Female, anterior end (ventral view); 4. Female, posterior portion (lateral view); 5. Female, showing vulva, true-vagina, uterine vagina and beginning of uteri; 6. Male, posterior portion (ventral view); 7. Male, posterior portion (lateral view); 8. Microfilaria from the blood.

Microfilariae from heart blood were stained with Wright's stain. Smears made by rubbing pieces of liver on slides revealed numerous ensheathed microfilariae in blood of liver also. Two small, oval, pearly cysts, 740 to 780 μ long by 289 to 305 μ wide, found on the surface of the liver, were opened with dissecting needles, and found to be tough connective tissue cysts, 15 μ thick, each containing a microfilaria; this finding of microfilaria in cysts appears to be unusual, but probably represents a defense reaction of a customary sort, commonly invoked against other parasites and perhaps invoked against microfilariae oftener than is supposed.

Microfilariae (Fig. 8) inclosed within a sheath which is considerably longer than the worm it contains. Larvae, excluding sheath, 190 to 280 μ long by 9 to 12 μ in maximum width. Anterior extremity bluntly rounded; body more or less uniform in width up to a point slightly posterior to the granular mass, tapering gradually from this point and terminating in a somewhat short digitiform tail. The anterior extremity of the larva did not take stain. Following a short area of a stained portion is the nerve ring which appears as an obliquely unstained band extending across width of body, 42 to 65 μ from anterior extremity. So-called "V spot," or excretory pore, opens to outside 10 to 20 μ posterior to nerve ring; excretory cell just posterior to excretory pore. Approximately at equator of body, 90 to 135 μ from anterior end, is beginning of so-called granular mass, a dark purple-stained area, extending postequatorially 35 to 60 μ . Of what appear to be the genital cells the first one is immediately posterior to granular mass, the second about 18 μ posterior to first cell, and the third and fourth cells arranged one behind the

TABLE 1. DIMENSIONS (IN MICRONS) AND PROPORTIONS OF SEVEN CARDIANEMA CISTUDINIS LARVAE FROM THE BLOOD OF TERRAPENE CAROLINA

	1	2	3	4	5	6	7
(1) Length (without sheath)....	190	200	210	220	240	268	280
(2) Maximum width.....	9	9	11	11	11	12	12
(3) Distance from anterior extremity to nerve ring.....	42	45	45	48	57	62	65
(4) Distance from nerve ring to excretory pore.....	10	10	15	15	15	20	20
(5) Length of tail.....	14	20	20	23	23	23	28
(6) Percentage of body length anterior to nerve ring.....	22.1	20.5	21.4	21.8	23.7	23.1	23.2
(7) Percentage of body length anterior to excretory pore.....	27.3	27.5	28.5	28.6	30	30.5	30.3
(8) Difference between (7) and (6).....	5.2	7	7.1	6.8	6.3	7.4	7.1
(9) Percentage of body length anterior to tail.....	92.6	90	90.4	89.5	90.4	91.4	90
(10) Distance from anterior extremity to granular mass..	90	100	108	115	120	125	135
(11) Length of granular mass....	40	35	38	45	42	45	60

other shortly posterior to second cell. The so-called tail-spot, another unstained area, is 14 to 28μ from tip of tail. Tail contains few stained elements.

Host.—Definitive: Turtle (*Terrapene carolina*); intermediate: unknown.

Location.—Adults in cavities of heart; ensheathed larvae in blood of primary host.

Distribution.—United States (Pennsylvania ?) and vicinity of Washington, D. C.

Specimens.—U. S. N. M. Helm. Coll. No. 32604.

Table 1 shows the principal measurements of seven larvae, and certain size relationships in percentages.

LITERATURE CITED

- Leidy, J. 1856.—A synopsis of entozoa and some of their ecto-congeners observed by the author: Proc. Acad. Nat. Sc. Phila., vol. 8 (1), pp. 42–58.
- Shikhobalov, N. 1930.—Sur une nouvelle filaria d'oiseaux: *Pseudaprocta gubernacularia* n. g., n. sp.: Ann. Parasitol. Humaine et Comp., vol. 8 (6), 1. Dec. pp. 624–627.
- Walton, A. C. 1928.—A revision of the nematodes of the Leidy collections: Proc. Acad. Nat. Sc. Phila. (1927), vol. 79, pp. 49–163.
- Walton, A. C. 1929.—A revision of the nematodes of the Leidy collections, corrections: Proc. Acad. Nat. Sc. Phila. (1928), vol. 80, p. 187.
- Yorke, W., and Maplestone, P. A. 1926.—The nematode parasites of vertebrates. With a foreword by C. W. Stiles, vol. 11, 536 pp. London.

ZOOLOGY.—*Egg-laying habits and larval stages of a milliped, Arctobolus marginatus (Say) Cook, native at Washington.*¹ H. F. LOOMIS, Bureau of Plant Industry. (Communicated by O. F. COOK.)

Early in the summer of 1916, Mr. H. S. Barber, of the U. S. National Museum, was collecting insects in the woods on the Virginia shore of the Potomac River at Plummer's Island, a short distance above the city of Washington, when beneath the loose bark of a fallen tree he discovered a female milliped of the large, cylindrical, native species, *Arctobolus marginatus* (Say) Cook, in the act of laying her eggs. As soon as he realized what the milliped was doing he replaced the bark without disturbing her, and ceased further investigation of the log. Several days later, on June 2, I visited the same spot with Mr. Barber and we began a careful search of the rotting tree trunk for millipeds or their eggs, both of which were found to be numerous,

¹ The notes forming the basis for this paper were made a number of years ago and are far from complete, but deal with interesting phases in the life history of an animal belonging to a little-known group of arthropods. As an opportunity for continuing the study may not present itself again it seems desirable to put these observations on record. Received October 5, 1932.